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SILICON SOLAR CELL PROCESS

DEVELOPMENT, FABRICATION, AND ANALYSIS

EIGHT QUARTERLY REPORT

FOR PERIOD COVERING

1 OCTOBER 1980 to 31 DECEMBER 1980

H.I. Yoo, P.A. Iles, and D.C. Leung

JPL CONTRACT NO. 955089

OPTICAL COATING LABORATORY, INC.
Photoelectronics Division
15251 E. Don Julian Road
City of Industry, California 91746

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ABSTRACT

During this reporting period, work included fabrication and characterization of solar cells from HEM, Dendritic Webs, and EFG ribbons. HEM solar cells showed only slight enhancement in cell performance after gettering steps (diffusion glass) were added. Dendritic webs from various growth runs indicated that performance of solar cells made from the webs was not as good as that of the conventional CZ cells. EFG ribbons grown in CO ambient showed significant improvement in silicon quality.

Efforts to passivate grain boundaries (G.B.) by preferential diffusion through G.B. did not result in improvement of sheet quality. Silicon sheets in these tests included SILSO, EFG, and Poly CZ.

TABLE OF CONTENTS

				PAGE
A BS1	'RAC'	Г		i
TABI	LE OF	CONT	ENTS	ii
LIST	OF T	ABLES		iv
LIST	OF FI	GURE:	S	v
# 4	INT	RODU	CTION	. 1
II.	TEC	HNICA	AL DISCUSSION	2
	A.	НЕМ	Solar Cells	2
		1.0	Solar Cell Fabrication	2
		2.0	Solar cell Performance and Characterization,	2
			Characteristics Under Illuminatio, Spectral	
			Response, Minority Carrier Diffusion Length	
	В.	Dend	ritic Web Solar Cells	8
		1.0	Solar Cell Fabrication	8
		2.0	Solar Cell Performance and Characterization,	8
			Characteristics Under Illumination, Spectral	
1			Response, Minority Carrier Diffusion Length	
	c.	EFG	Solar Cells	14
		1.0	Solar Cell Fabrication	14
		2.0	Solar Cell Performance and Characterization,	14
			EFG Cells with CO in Embient, EFG Cells With	
			Low Temperature Annealing.	**************************************
	D.	Solar	Cells From Two Step Diffusion	20
		1.0	Solar Cell Fabrication	20
		2.0	Solar Cell Performance	20

			<u>PAGE</u>
III.	CON	NCLUSIONS AND RECOMMENDATIONS	22
ıv.	WOE	RK PLAN STATUS	23
٧.	REF	ERENCES	2 4
	498	PENDIXES	
	J.	Time Schedule	
	II.	Abbreviations	
	III.	Electrical Data Sheets for HEM Solar Cells	
	IV.	Electrical Data Sheets for Dendritic Web Solar Cells	
	٧.	Electrical Data Sheets for EFG Solar Cells	
	VI.	Flectrical Data Sheets for Solar Cells From Two Step Diffusion	,

LIST OF TABLES

TABLE		PAGE
1	Dendritic Web Solar Cell From Baseline Process	10
2	Dendritic Web Solar Cells From Advanced Process	11
3	Average Cell Parameters of EFG Ribbons With and Without CO-In Ambient	16
4	Minority Carrier Diffusion Length of Selected Solar Cells From EFG Ribbons With and Without CO-In Ambient	16
5	EFG Material With Low Temperature Annealing (600°C, 3 Hr.)	17
6	Average Short Circuit Current Density (Jsc/mA/cm ²) For Two Step Diffusion Process (750°C, 9Hr., In POCL ₂)	21

LIST OF FIGURES

FIGURE I	Short Circuit Current Density of HEM Baseline Solar Cells With and Without the Gettering As a Function of Wafer Position	PAGE 4
2	Efficiency (Normalized WRT The CZ Control Cells) Mapping of Vertically Cut HEM Baseline Cells With The Gettering Steps Added	5
3	Spectral Response of the Baseline Solar Cells From HEM (Top Section of Ingot #41-07)	6
4	Spectral Response of the Baseline Solar Cells From HEM (Bottom Section of Ingot #41-07).	7
5	Spectral Response of the Baseline Solar Cells From Dendritic Webs	12
6	Spectral Response of the BSF Solar Cells From Dendritic Web	13
7	Spectral Response of the Baseline Solar Cells From EFG With CO-On	18
8	Spectral Response of the Baseline Solar Cells From EFG With CO-Off	19

I. INTRODUCTION

The objective of this program is to investigate, develop, and utilize technologies appropriate and necessary for improving the efficiency of solar cells made from various unconventional silicon sheets. During the reporting period, work included fabrication and evaluation of solar cells from HEM (Crystal Systems), dendritic web (Westinghouse), and EFG (Mobil-Tyco). Baseline solar cells were fabricated from HEM wafers after diffusion glass gettering. Baseline and advanced solar cells were fabricated from dendritic webs of various runs. Baseline solar cells were fabricated from EFG (RH) ribbons grown in a furnace with CO-on and CO-off atmosphere and performance results were compared.

Two other process variations (Two step diffusion and low temperature annealing) were applied to some of the sheet silicon. In an effort to passivate grain boundaries, two step diffusion was carried out on materials, such as SILSO, EFG, and Poly CZ wafers. Low temperature annealing was applied on earlier EFG (RH) ribbons in an attempt to restore thermal stress which might be introduced during the ribbon growth. Baseline solar cells were fabricated after these treatments and their performance was compared with that of solar cells that had not undergone these process variations.

II. TECHNICAL DISCUSSION

A. HEM Solar Cells

1.0 Solar Cell Fabrication

Baseline solar cells were fabricated on wafers cut from an HEM ingot (4"x 4"x 4", #41-07) with a gettering step added. The gettering step was applied to chemically polished HEM wafers by forming diffusion glasses at 875°C for about an hour (oxygen bubbling through POC1₃ source). After this step, chemical polishing removed the diffused layer. Baseline solar cells were fabricated on wafers prepared from different positions within the ingot.

Gettering by the diffusion glass was also carried out on vertically cut wafers from a whole HEM ingot (#41-20). Two gettering experiments were made; one on the cleaned saw-cut wafers and the other on the chemically polished wafers. The diffusion glass was formed the same way described above. (See Reference (1) for the detailed description of the HEM process.)

2.0 Solar Cell Performance and Characterization

Characteristics Under Illumination

Finished baseline solar cells had SiO AR coating and about 90% active area with Ti-Pd-Ag metallization. Solar cell parameters, such as Isc, Voc, CFF, and n, were measured under an AM1 conditions at 28°C test block temperature. Appendix III provides individual parameters of the gettered cells from ingot #41-07. Figure 1 is a plot of a short circuit current density versus wafer position, with and without the gettering step added, indicating improvement of about 0.5 1 mA/cm² by the gettering. Generally, this is similar to results in the Seventh Quarterly Report, however, slight discrepancy in the degree of improvement at various position was noticed.

Appendix IV shows parameters of the baseline cells from ingot #41-20 with the gettering step done on the saw-cut HEM and the chemically polished HEM, respectively. Normalized efficiencies with respect to the CZ control cells are given in Figure 2. The result suggested, compared with the baseline cells without the gettering reported in the Seventh Quarterly Report; 1) Dependence of cell performance on the location is similar, and 2) no significant improvement in cell performance was noticed after the gettering.

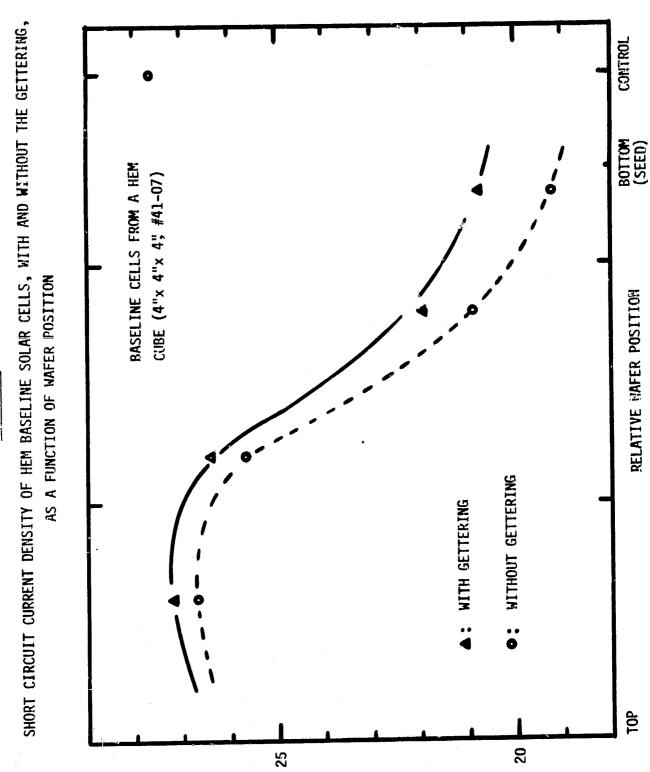
Spectral Response

Absolute spectral response (A/W) was made using a filter wheel set-up. (See Appendix V of reference (2) for the details.) Response versus wavelength of the baseline cells with and without gettering is given in Figure 3 for HEM cells from the top (3-series) and Figure 4 for HEM cells from the bottom (11-series). The HEM cell from the top does not show any significant improvement in the response. However, the cells from the bottom showed noticeable improvement in long wavelength region.

Minority Carrier Diffusion Length

Minority carrier diffusion length (L) was measured on the same solar cells used to measure spectral response, using the short circuit current method. The L-value of the top HEM cells with and without the gettering was about the same (120um). Some improvement in L was obtained for the bottom HEM cells after gettering; a gain of 15um for the gettered cell (#11-7) and 9um for the cells without gettering.

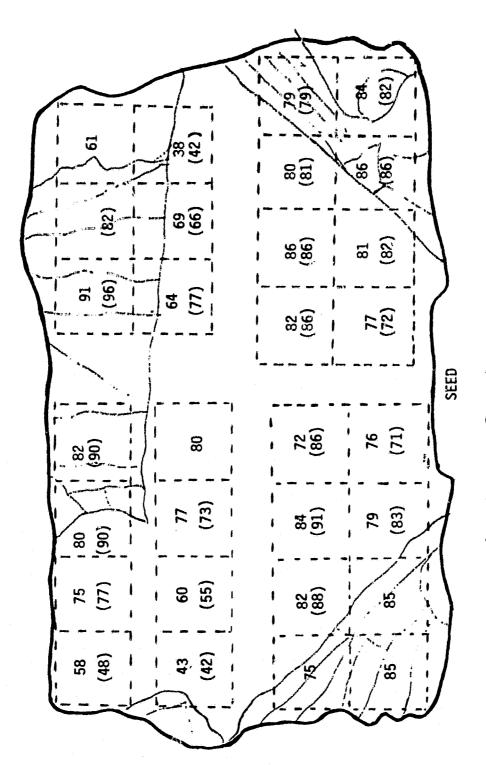
FIGURE 1



SHORT CIRCUIT CURRENT DENSITY (AM1), mA/cm2

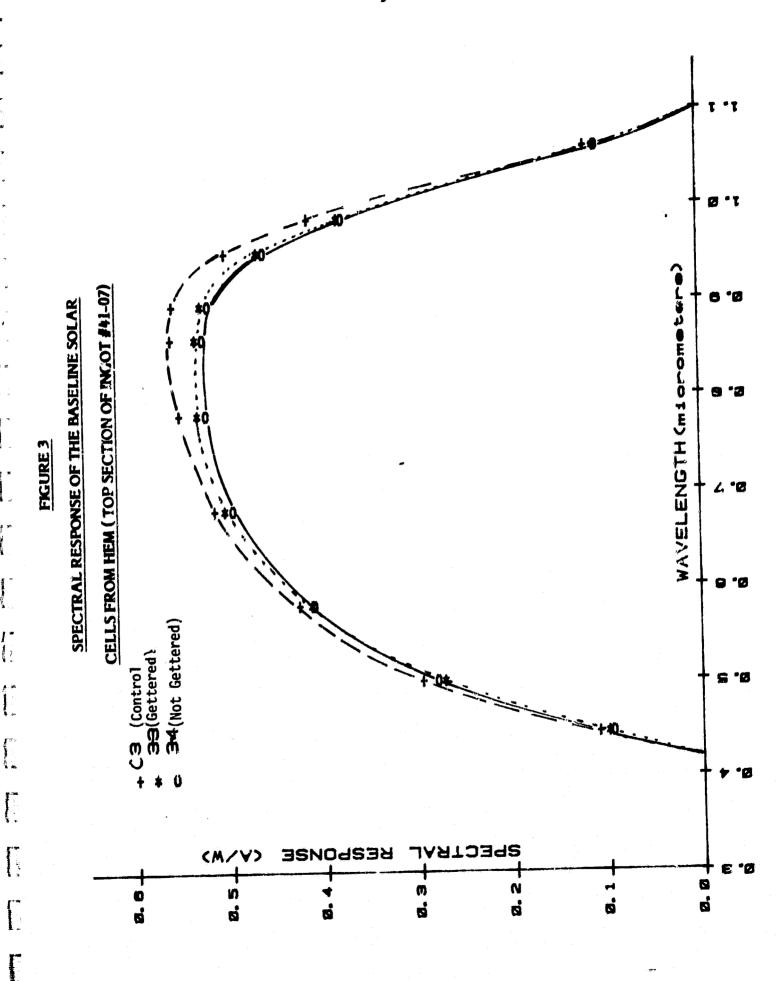
EFFICIENCY (NORMALIZED WRT THE CZ CONTROL CELLS) MAPPING OF VERTICALLY CUT HEM BASELINE CELLS WITH THE GETTERING STEPS ADDED

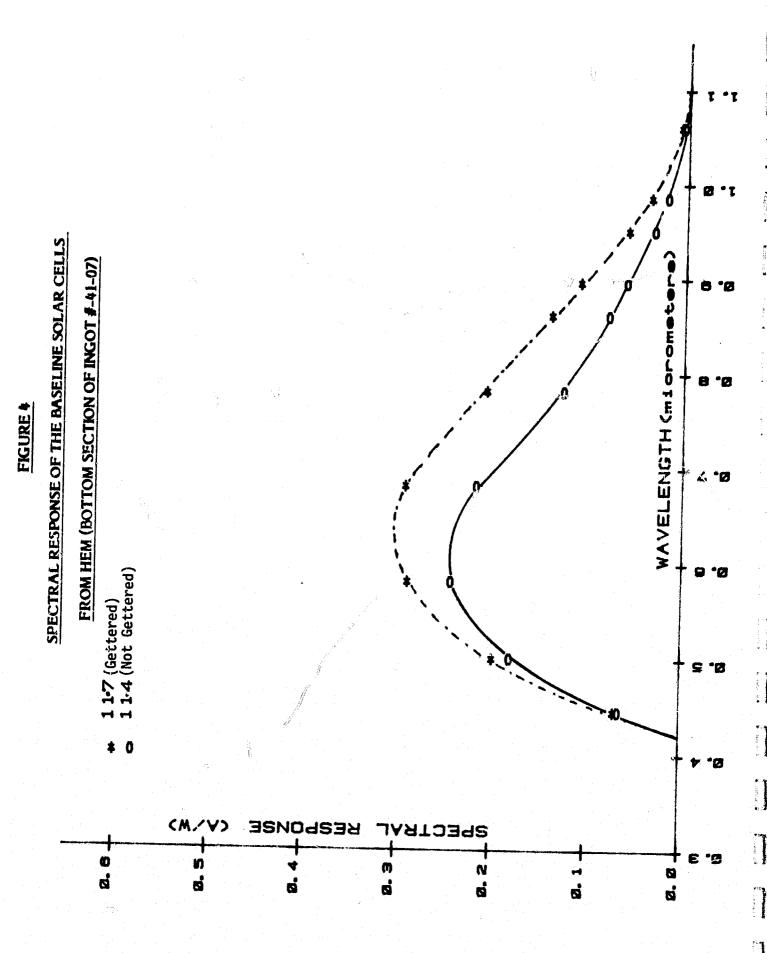
FIGURE 2



NOTE: 1) Unit: Percentage

2) Parenthesis numbers for the cells with the gettering step done after the chemical polishing.





B. Dendritic Web Solar Cells

1.0 Solar Cell Fabrication

Blank shaping (2x2cm) and removal of the surface deposit (SiO) were carried out using the same method described in Section E of Reference (2). (See Reference (3) for the details of dendritic web process.) Baseline solar cells were fabricated from dendritic webs for various runs; Run 17-1373 (J176-213, 8.5 ohm-cm), 17-1377 (J22v-2.6, 3.4 ohm-cm), and 17-1390 (J183-1.5, 9.4 ohm-cm).

Efforts were made to improve the performance by forming a shallow junction, using fine grid lines, BSF and MLAR coating. Baseline solar cells were also fabricated from the same webs and the results were compared. Dendritic webs tested were #17-1387 (J180-2.7, 8 ohm-cm), 17-1388 (J181-3.7, 11 ohm-cm), 17-1389 (J181-3.8, 11 ohm-cm), and 17-1402 (AA009-4.4, 3 ohm-cm).

2.0 Solar Cell Performance and Characterization

Characteristics Under Illumination

Finished solar cells were tested under AM1 condition at 28°C test block temperature. Individual cell parameters are given in Appendix IV. Table 1 summarizes cell parameters of the baseline process, indicating an average efficiency slightly higher than 11% for dendritic web cells. NOTE: The average efficiency of the CZ control cells (starting substrate resistivity of 1-3 ohm-cm) was about 13%. Lower efficiency of the web cells was mainly due to lower open circuit voltage, caused by the higher starting substrate resistivity of the webs. Short circuit current density of the web cell was lower than the control cells, (by about 1mA/cm²) suggesting that the quality of the webs under investigation is not so good as that of conventional CZ silicon.

Cell parameters from the advanced process are summarized in Table 2, showing an average efficiency of 12.5% which is an efficiency improvement of about 1% over the baseline solar cells. Open circuit voltage en ancement by the BSF process does not seem to be as effective as before. The reason for the small improvement in Voc is not known at present.

Spectral Response

Absolute spectral response (A/W) was obtained using a filter wheel set-up. The results are plotted in Figure 5 for the baseline solar cells and Figure 6 for the cell from the advanced process. The web cells show response close to those of the CZ control cells, yet showing slightly lower response in the long wavelength region.

Minority Carrier Diffusion Length

Minority carrier diffusion length ($L_{\rm D}$) was measured by the filter wheel method using the short circuit current method. Selected samples were measured by illuminating the whole area. The results showed values of about 130um for #6 cell (from web I.D. #17-1373), and 110um for #14 cell (from web I.D. #17-1377), while $L_{\rm D}$ of the CZ control cell indicated about 150um.

TABLE 1

DENDRITIC WEB SOLAR CELL FROM BASELINE PROCESS

	- 6-A	WE	B I.D. NO.		
		17-1373 ρ=8.5 Ω- cm	17-1377 p=3.4Ω-cm	17-1390 ρ=9.4Ω-cm	CZ CONTROL
	AV.	532	534	515	588
Voc (mV)	S.D.	530~534	532≈536	512~518	584~590
	R	2	2	3	3
Jsc	AV.	28.8	28.1	28.6	29.8
(mA/cm ²)	S.D.	0.5	0.3	0.5	0.5
ž	R	28.3~29.4	27.8-28.4	27.4~29.0	29.3~30.0
CFF	AV.	76	76	75	74
(%)	S.D.	1	1	1	3
	R	75~76	75 ~ 76	74~77	70~76
\sim	AV.	11.6	11.4	11.0	13.0
(%)	S.D.	0.1	0.1	0.2	0.6
	. R	11.4~11.7	11.3~11.5	10.6~11.3	12.2~13.5

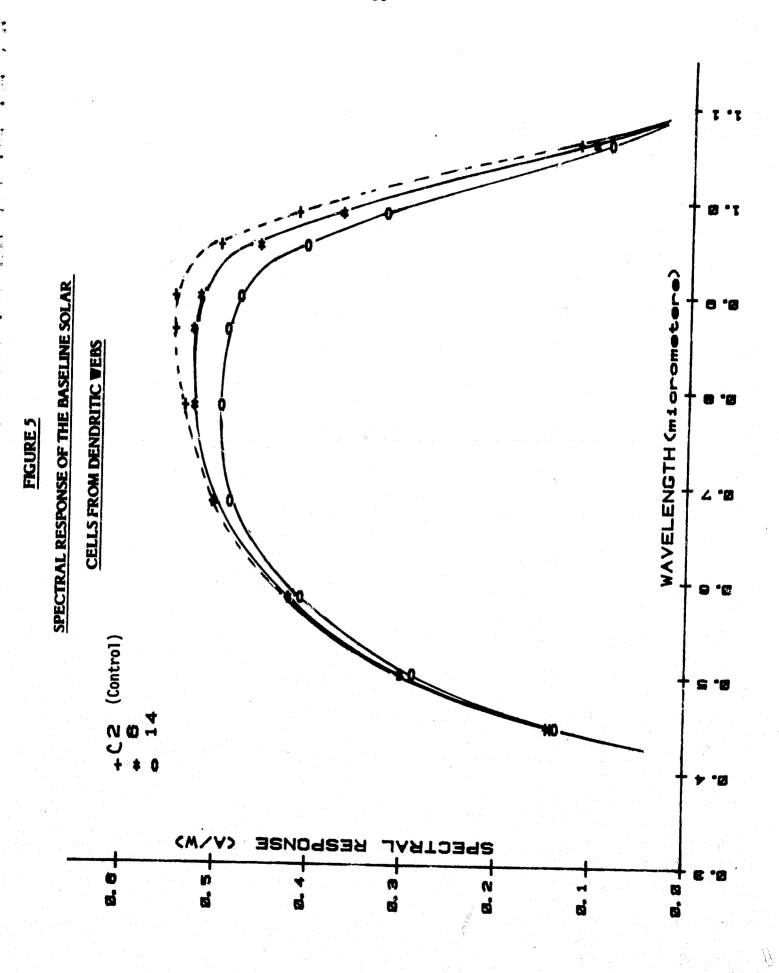
NOTE: 1) 2x2 cm cells under AM1 measured at 28°C test block temperature.

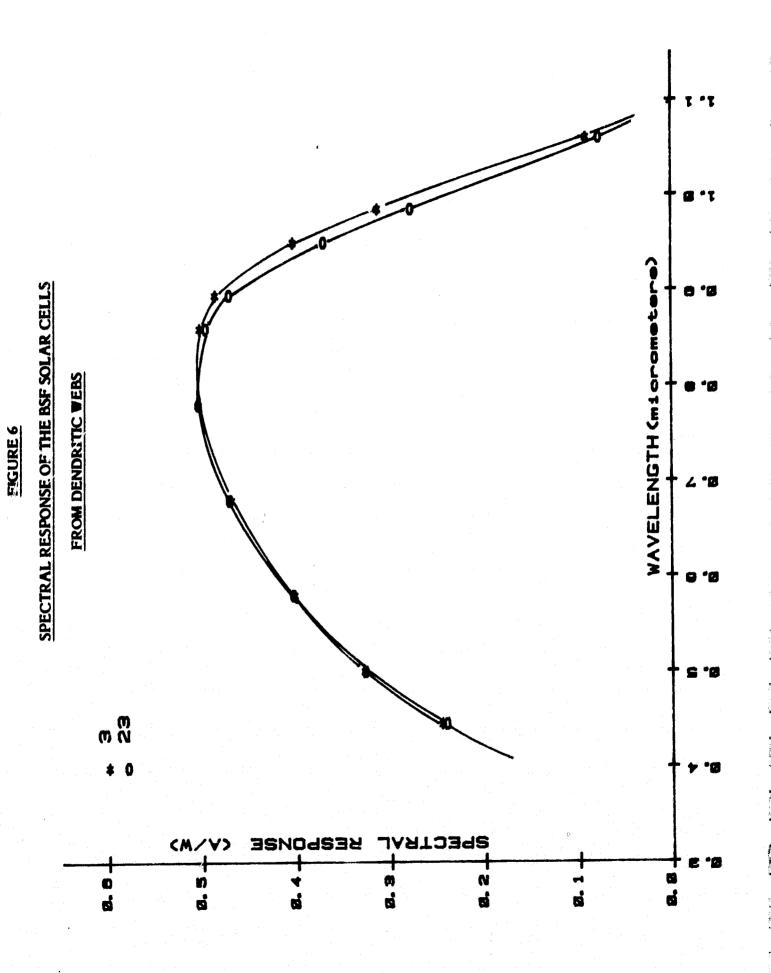
DENDRITIC WEB SOLAR CELLS FROM ADVANCED PROCESS

			CONTROL CE	LLS (NO BSF)
		WEB	WEB	CZ
	AV.	545	531	581
Voc (mV)	S.D.	14	11	-
, , , ,	R	582-558	514-546	578582
Jsc	AV.	29.2	28.1	29.9
(mA/cm ²)	S.D.	0.6	0.5	-
	R	28.5-29.8	27.4-28.8	29.3 - 30.4
	AV.	79	78	78
CFF (%)	S.D.	1	1	1
	R	7880	75-79	7779
~	AV.	12.5	11.7	13.5
(%)	S.D.	0.6	0.5	•
(6)	R	11:8-13.0	10.9 -12.2	13.2 – 13.7

NOTE: 1) Measured under AM1 at 28°C test block temperature.

2) Advanced process: SJ+BSF+MLAR





C. EFG Solar Cells

1.0 Solar Cell Fabrication

EFG ribbons evaluated had been grown in a furnace with CO-off (Run #18-191-0) and Co-on (Run #18-196-1) atmosphere. (Reference (4) provides technical details of the EFG process.) The ribbons were sliced into 2x2cm blanks using a dicing saw and baseline solar cells were fabricated alongside with CZ silicon (control cell) for comparison. (Refer to Appendix IV of Reference (2) for the details of the baseline (standard) process.)

In an effort to reduce potential residual thermal stress before the cell processing, low temperature annealing was tried on earlier EFG ribbons (Run #187-3C series). The EFG blanks were thoroughly cleaned and annealed at 600°C for 48 hours in nitrogen atmosphere. Baseline solar cells were made from both annealed and un-annealed EFG ribbons and the cell performance was compared to see the effect of the annealing.

2.0 Solar Cell Performance and Characterization

Solar Cells From EFG Grown with CO in Ambient

The products from the baseline process had SiO AR coatings and about 90% active area with Ti-Pd-Ag metallization scheme. Solar cell parameters such as Jsc, Voc, CFF, and n were measured under AM1 conditions at 28°C. Individual cell parameters are given in Appendix V and Table 3 summarizes the results. The EFG cells grown in CO ambient showed improvement in all cell parameters, resulting in an average efficiency of 10.7% AM1 compared with 8.6% of the EFG cells without CO in ambient.

Absolute spectral response (A/W) was made using a filter wheel setup. Response versus wavelength of the baseline solar cells is given in Figure 7 for the EFG

cells with CO-on and Figure 8 for the EFG cells with CO-off. Representative good and bad cells are shown in the figures. The figure suggests that EFG ribbon cells grown in CO atmosphere show higher response in the long wavelength region, indicating higher minority carrier diffusion length with better quality of the silicon.

Minority carrier diffusion length was measured using the short circuit current method for the finished solar cells. Solar cells were selected from short circuit current density information and the results are summarized in Table 4. The Table indicates a range of diffusion length between 35 50um for the EFG with CO-on and 25 35um for the EFG with CO-off. The diffusion length of the CZ control cell was about 140um.

EFG Cells with Low Temperature Annealing

Baseline solar cells were measured under AM1 without AR coating. Individual cell parameters are given in Appendix V and Table 5 summarizes the results. The table suggests the annealing test did not result in improvement of the sheet quality.

AVERAGE CELL PARAMETERS OF EFG RIBBONS WITH AND
WITHOUT CO IN AMBIENT

	Voc, mV	Jsc mA/cm ²	CFF, %	, %
WITHOUT CO	540	22.9	70	8.6
WITH CO	567	25.1	76	10.7
CZ CONTROL	582	28.2	78	12.7

NOTE: Baseline Solar Cells (2x2cm) With SiO AR Measured at 28°C Under AMI.

TABLE 4

MINORITY CARRIER DIFFUSION LENGTH LENGTH OF

SELECTED SOLAR CELLS FROM EFG RIBBONS WITH AND WITHOUT

CO IN AMBIENT

	EFG W	ITH CO	EFG WI	тноит со	CZ
CELL I.D.	#8	#10	#7	#3	CONTROL
DIFFUSION LENGTH (um)	50	35	35	25	140

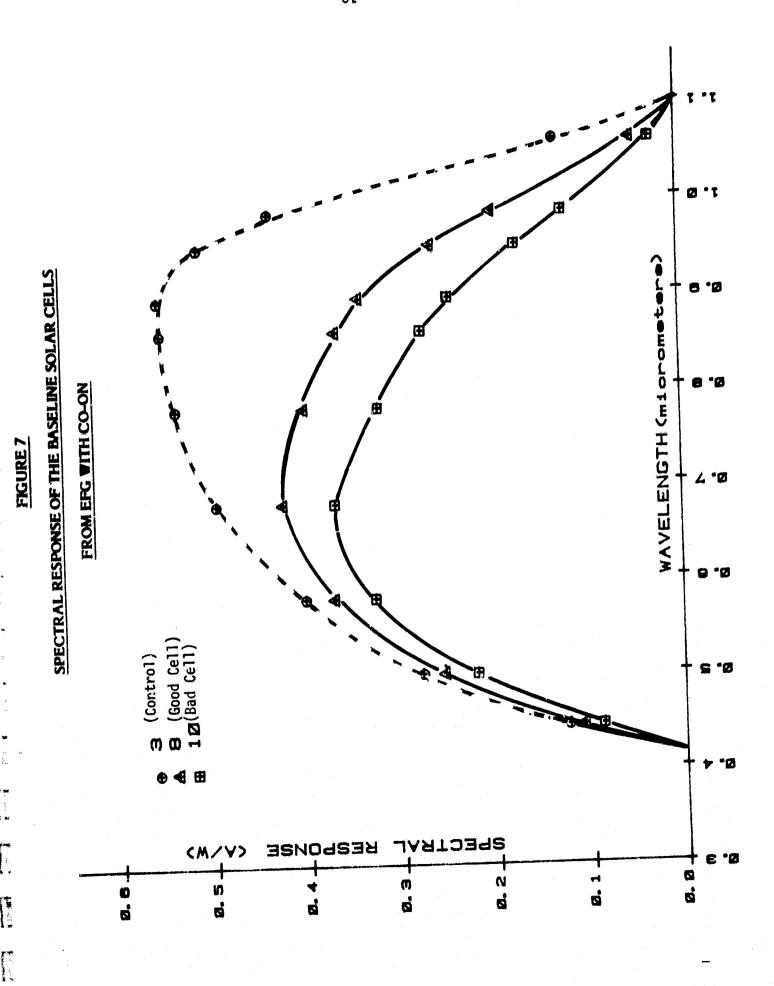
NOTE: Diffusion Length (effective) Measured on Whole Area (2x2cm) Using Short Circuit Current Method.

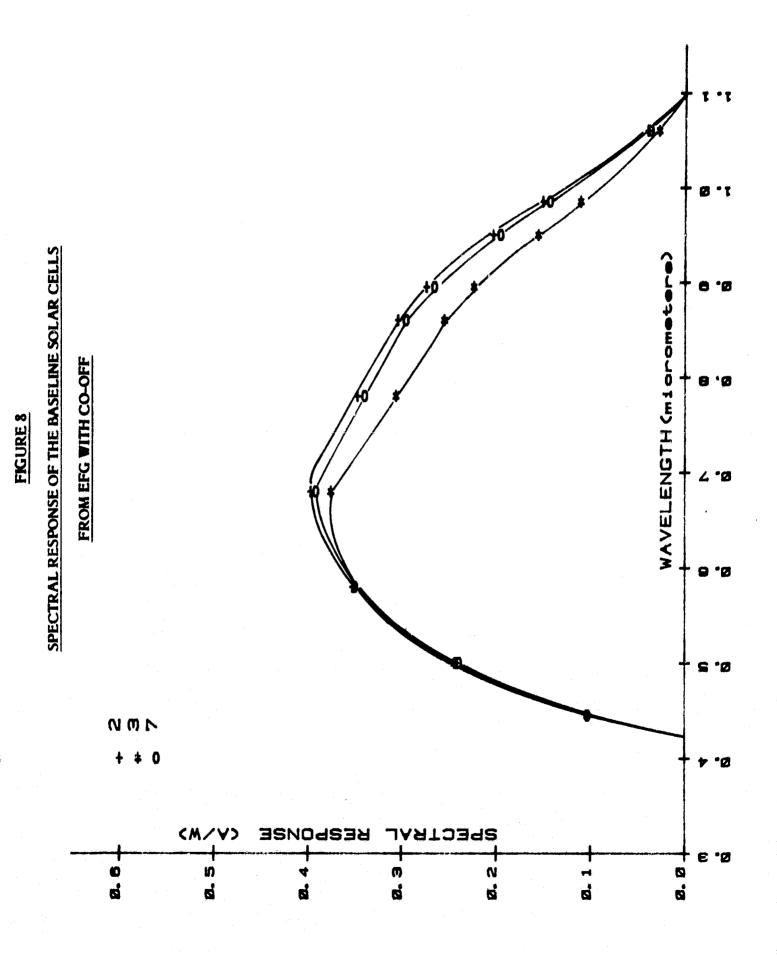
TABLE 5

EFG MATERIAL WITH LOW TEMPERATURE ANNEALING (600°C,30 Hr)

	Voc,mV	Jsc ₂ mA/cm ²	CFF %	M %
NOT ANNEALED	493	13.2	74	4.8
ANNEALED	493	13.3	73	4.7
CZ CONTROL	568	20.1	74	8.5

BASELINE PROCESS ON 2×2 CELLS <u>WITHOUT</u> AR MEASURED AT AM1 AT 28° C. (EFG MATERIAL WITHOUT CO IN THEIR GROWTH)





D_{*} Solar Cells From Two Step Diffusion

1.0 Solar Cell Fabrication

Since significant improvement in solar cell performance, specifically short circuit current, was reported (5) at the 1980 European Photovoltaic Solar Energy Conference by utilizing two step diffusion, an experiment was carried out to try and reproduce the tests. Silicon sheets under test were SILSO (Wacker), EFG, and poly silicon from CZ growth. The first step diffusion included 9 hours of POCl₃ diffusion at 750°C, it was hoped that preferential diffusion at grain boundaries would occur at this stage. Normal diffusion at 875°C followed thereafter and baseline solar cells (2x2cm) were fabricated. Half of the samples were inserted during the second stage diffusion (normal 875°C diffusion), serving as control cells, to compare the results of the cells with two step diffusion. No AR coating was applied to these cells.

2.0 Solar Cell Performance

The solar cells were tested under AM1 conditions (no AR coating). Individual cell parameters are given in Appendix VI. The cell data indicated that none of the silicon sheets showed improvements in solar cell parameters. Table 6 shows a comparison of short circuit cu..ent density of the solar cells with and without the two step diffusion.

Jsc of poly CZ and SILSO cells stayed about the same, while EFG cells showed reduction in Jsc after the first step diffusion.

TABLE 6

AVERAGE SHORT CIRCUIT CURRENT DENSITY (Jsc, mA/cm²) FOR TWO STEP DIFFUSION PROCESS (750°C, 9Hr. in POC1₃)

	EFG	POLY Hamco	SILS0
No 2 Step Diffusion	17.9	22.1	22.4
2 Step DIFFUSION	15.3	22.1	22.3

Jsc of Control: 23.4

Baseline process on 2x2 cells without AR, measured at AM1, 28°C. (EFG material without CO in growth)

III. CONCLUSIONS AND RECOMMENDATIONS

The conclusions and recommendations reached after processing and evaluation of the sheets are as follows:

HEM

- o Gettering by diffusion glass on two ingots resulted in only a slight improvement in cell efficiency, the degree of enhancement depending on the position of the wafers within the ingots.
- o Gettering results suggest that microscopic analysis of structural defects and impurities, especially inclusions or precipitates, is necessary to identify the potential areas of degrading silicon sheet quality.

Dendritic Web

o Baseline solar cells from dendritic webs of various runs suggested that quality of the webs under investigation was not as good as the conventional CZ silicon, and was slightly sooner than that of the better web samples tested earlier.

EFG

- o EFG ribbons grown with CO in the ambient showed significant improvement in silicon quality, resulting in an average baseline efficiency of 10.7% AM1 compared with 8.6% of the EFG cells without CO in the ambient.
- o Low temperature annealing prior to the cell process did not result in improvement in silicon quality.

Two Step Diffusion Process

e Efforts to passivate grain boundary by preferential diffusion, 9 hours of POCl₃ diffusion at 750°C, did not result in enhancement of the quality of silicon sheets (SILSO, EFG, or Poly CZ).

IV. WORK PLAN STATUS

The following silicon sheets are expected for processing and evaluation during the next period.

- o Three dimentional evaluation of large HEM ingots.
- o Fabrication of solar cells from the pre-characterized dendritic webs.
- o Fabrication and performance comparison of EFG ribbons grown in CO₂-on and CO₂-off atmosphere.

V. REFERENCES

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- 2. H.I. Yoo, et.al., "Silicon Solar Cell Process Development, Fabrication, and Analysis". JPL Contract No. 955089, Annual Report (Phase I), June 1979.
- 3. C.S. Duncan, et.al., "Silicon Web Process". JPL Contract No. 954654,
 Technical Report, Westinghouse.
- 4. F.V. Wald, et.al., "Large Area Silicon Sheet by EFG". JPL Contract No. 954355, Technical Reports for the LSA Project, Mobil-Tyco.
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APPENDIX I

TIME SCHEDULE

TASK	JUL	AUG	SEP	ОСТ	NOV	DEC	JAN	FEB	MAR	APR	MAY	NUC	JUL
1. PROCESS SHEET SAMPLES							·						
a) Baseline Process	ì												
b) Analysis													
c) Back Up Measurements				,,									
d) Test Alternate Process													مان بنید شد
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2. REPORTS									***				al alganis bayanna aguna
a) Monthly		•	4	(4	4	•	٥	٥	<	٥	٥	
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3. INTEGRATION MEETING												ــــــــــــــــــــــــــــــــــــــ	

APPENDIX II
ABBREVIATIONS

 $oldsymbol{v_{oc}}:=oldsymbol{o}_{b}$ on change follows:

Tsc: Shart Circuit Current

J_{SC}: Thort Giesuit Current Density

 I_{SCR} : Short Circuit Current (Red R. ponse) at Navelength Above -.6 μm

 I_{SCB} : Short Circuit Current (Blue R-sponse) at Wavelength Below \sim .6 μm

CFF: Curve Fill Factor

7: Solar Cell Conversion Efficiency

L: Minority Carrier Diffusion Length (D.L.)

I Current at Maximum Power Point

V_{MAX}: Voltage at Maximum Power Point

P_{MAX}: Maximum Power Point

BSF: Back Surface Field

BSR: Back Surface Reflector

V_R: Bias Voltage

I .: Diode Saturation Current

HEM: Heat Exchanger Method

EFG: Edge Defined Film-Fed Growth

SOC: Silicon on Ceramic

RTR: Ribbon-to-Ribbon

SPV: Surface Photovoltage

MLAR: Multi-Layer Anti-Reflective

R_s: Series Resistance

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APPENDIX III ELECTRICAL DATA SHEETS FOR HEM SOLAR CELLS

CELL DESCRIPTION:

TEST CONDITION: TEMPERATURE:

Baseline Solar Cells from a HEM Cube (#41-07)
Gettering by diffusion glass after the chemical polishing.
AM1 with SiO AR Coating.
28°C Test Block

	V _{oc}	Jsc	P _{Max}	CFF	n.	AREA
NO.	mV	ınA/cm ²	mW	%	**************************************	cm ²
3-1	574	220	. S. Alkida aggryyn, ann ai nthan airin	23	//.3	3.9
3-3	526	225	ரா ல் கத்திரு. பார்ஷ் சு றுக ்கும் வல்ல் ™ உரு	23	11.6	T. E.
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3-2	582	22.4	रंग केट - १ ता - विकास विकास रहते.	78	12.4	T IS BEEN DRIVEN THE FRANCISCH PROPRIEST OF THE
3-9	580	22.0	京都で s s p s supplies - 2000 Fr 2005 - 日	72	12.1	A essen is the essent limitation (Size) (Newson) (Size)
6:1	580	27.4	- Anno - Anno Liain anno anno anno a	26	12.1	
6-3	522	26.0	nd in falsindern den nogges ny systym i der in dyr didynd den den ennesyl, den	75	11.1	NO THE TEXT THE DATE OF THE TEXT OF THE TE
6.5	568	26.6	o Noja koostoo iliiga oyingiga koo iliya ahakka kayay kojayaalakk	74	11.2	nan sinanci samonia samannonymotazoni s m
6-7	528	26.4		77	11.7	l l
621	566	25.4	artinonyanap, aya kityaan kipan majaan kananga kalaming	74	10.6	and the second s
9-/	548	22.6	nchings was the boson below the organization and the control of th	77	9.5	"
9-3	546	22.5	· ought (exceptional color)	77	9.4	//
9-5	544	22.5	क्षेत्रकारम् क्षेत्रकारम् का (स्तः नाः । भागमान्त्रकारम् वर् गासम्बद्धसम्बद्धसम्बद्धसम्बद्धसम्बद्धसम्बद्धसम्बद्धसम	75	9.2	
9-2	544	22.6	स्ट देखा विकास देखा — क्षा क्षा क्षा क्षा क्षा क्षा क्षा क्षा	25	9.3	/1
9-21	522	19.2		78	7.8	"
]]-	518	19.6	and the state of t	75	2.6	"
11.7	532	23.1	·	74	9.1	"
11-11	520	20.7		74	8.0	
<i>11-13</i>	5/0	19.6		2.3	7.3	11
12-27	508	18.7	or Grown the state of the state	73	2.0	"

(Continued)

SOLAR CELL FLECTRICAL DATA

CELL DESCRIPTION:

Baseline Solar Cells from a HEM Cube (#41-07)

TEST CONDITION: TEMPERATURE:

Control Cells for Gettering Test
AM1 with SiO AR Coating
28°C Test Block

no and and and a second and a second	yras:::awsae.rs:a.r.y	o a markatura ili sa alamatura		THE SELECTION SERVICE	** 2 **********	. Paragraph statement participation
	v _{oc}	^J sc	P _{Max}	CFF	ŋ	AREA'
NO.	mγ	mA/cm ²	mW	A second	***************************************	cm ²
3-2	576	25.9	The second secon	78	11.6	3.9
3-4	576	27.0	・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・	74	11.5	•/
3-6	576	26.9	NEXTE AN improvement of the self-in the	78	12.0	
3-8	578	26.9	(f2.),(235), 4 manual - milion (f2.)	77	120	1/
6.2	574	25.9	50) - On sephen-Rosselle, illustra . All Cales and decide in Sec.	74	11.1	//
6-4	576	25.5		76	11.2	1+
6-6	576	26.9		78	12.0	//
6.20	566	24.4	t - O gryndeller flyg kannen e syst.	76	10.5	//
6-22	576	26.4	Compression Anni Republication of State (Control Anni Anni Anni Anni Anni Anni Anni Ann	78	11.8	0
9-2	540	21.0		77	88	1/
9-4	552	22.6		77	9.6	
9-6	536	20.0	and section as part of the design of the Control of	76	8.2	//
9-20	538	21.1	enpayorga aninghaanay ogo to brown/uscopeaninins/sasa	77	8.7	
9-22	532	20.0	g Thispappinisteninanian thing - da is heiryceis sisse No. Abb	74	7.9	- 17
11-4	5/2	19.7	and the second s	7/	7.2	, <i>11</i>
12-28	508	18.7	المراجعة	73	2.0	: 1/
		C7 (0	trol cells	(Down).	
C-1	576	27.5	. ·	77	12.2	3.9
C-2	574	27.4		78	12.2	11
C-3	574	28.0		76	12.1	1)

CELL DESCRIPTION:

Baseline Solar Cells from a HEM Ingot (Vertically Cut)
Gettering by Diffusion Glass before the Chemical Polishing
AM1 with SiO AR Coating
28°C Test Block

TEST CONDITION:

TEMPERATURE:

NO.	V _{OC}	Jsc	P _{Max}	CFF	n	AREA
	mV	mA/cm ²	mW	8	*	cm ²
	516	19.6		74	7.5	3.9
2	544	24.2	C Nada Galla G	75	9.8	//
3	560	26.8	ilikasi (painemanananananananananananananananananana	69	10.4	- 11
4	560	26.2		73	10.7	
5	572	27.4	rines paresses procedural (C. Milichaldina) de Send	75	11.8	//
6	538	25.2	, marganis and the second of the second	<u> </u>	7.5	//
2	524	30.6	gagyssystellisetheideskiskiskis Coloren hygnen pyneddytall	73	7.9	11
8	480	15.6	e patriana de la companya de la comp	25	5.6	11
9	526	19.5	LMCSAL (pMSSSA + ++++	76	7.8	1)
_/0	548	23.7	operated and have provided the second	77	10.0	//
	554	24.7		76	10.4	И
12	540	242	entransia (Company)	64	8.3	()
	<u>536</u>	22.1	Andre C. Belleville Statement and Assessment Statement and Assessment Statement and Assessment Statement S	75	8.9	11
14	476	15.0	and the state of t	68	4.9	. 11
15	538	24.4		74	9.7	(1
16	568	26.4		72	10.7	<u>' 11</u>
17	564	26.3		73	10.9	11
. 18	552	25.8		66	9.4	11
19	558	25.8		76	10.6	f1
20	564	36.3	- Andrews	75	11.2	//
21	568	26.8	the second second second	68	10.4	//
22	552	25.4		74	10.3	<i>''</i>

(Continued)

SOLAR CELL ELECTRICAL DATA

TEST CONDITION: TEMPERATURE:

CELL DESCRIPTION: Baseline Solar Cells from a HEM Ingot (Vertically Cut)
Gettering by diffusion glass before the Chemical Polishing

AM1 with SiO AR Coating 280C Test Block

The second secon	v _{oc}	J _{SC}	P _{Max}	CFF	n	AREA
NO.	mV	mA/cm ²	mW	\$	*	cm ²
23	562	26.7		74	11.1	3,9
. 24	558	25.8	· Andrews and Angels a	77	/1.1	11,
25	552	24.9		75	10.3	11
26	548	24.8		73	9.9	11
27	546	24.9	- and residence of the second	74	10.0	- 11
28	552	25.2		75	10.5	11
29	560	25.8	+ 27 nic symmetric (18 Theory and 20 CA) (18 Million Chr 18 Million Chr.	77	11.2	11
30	558	24.3	one deliver de l'industrial de l'année de l'industrial de l'in	74	10.9	11
	The	CZ cents	ol cells	without	gette	ring (Down)
C-1	590	28.4		78	13.0	
C-2	590	28.5		79	13.2	11
C-4	590	28.5	·	77	12.9	11
		-administration (and the action of the actio	Angelian (and the same of the same of the same			
·		nandhí an dá al 2004, an aigsgiús tá an agaigteár marta (t. hardinn 25 sy spraige sprai		and the second of the second o		

,						
	x	nas urani paun jā <u>nā pa</u> nā pa pā pā pa	***			
					EsiQ uinter il calcentrate car	

CELL DESCRIPTION:
Baseline Solar Cells from a HEM Ingot (Vertically Cut)
Gettering by diffusion glass after the Chemical Polishing
AM1 with AR Coating
TEMPERATURE:
28°C Test Block

Al Al a Amerika merlepak erren erre ber	Voc	Jsc	P _{Max}	CFF	γ	AREA
NO.	mV	mA/cm ²	nW	***************************************	*	cm ²
31	504	19.5	THE RESERVE THE THE PART OF TH	61	6.0	3.9
32	546	24.8		71	9.6	
33	568	26.7	en der führ der dinsen in de dendesen besender	74	11.2	
34	562	26.3	TOWNS MODULE STATE OF THE SECOND STATE OF THE	76	11.2	
35	574	26.9	entroppedeuts (proceeds librarius) (c	78	120	and second company of the second company of
36	554	25.2	n volatinistis Totaleene allerielle. Valuestistelle annetspellistissee Schlottische in	74	10.3	2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
37	470	20.6	w manacki kick においままで ボー・・ スピボール and kade and kick	34	.35	H Cara a Todo ozo omaanianamoon
38	428	15.5	- administration 1820 and another the comparison of the second se	2000 - 10	.5.2	. ACC UNBERBAS JUNC - SEA SEA SEA STATEMENT DE MANTENES DE MANTENE
39	516	20.8	yan kadi lihiri miganin ya kinid jab. Hiliki miyyyo pinan digini yegib Malin	45	6.9	MALLESSAMIALLA A COMMUNICATIONNAS SAMANAS ARMANDOS MARTINAS PROPERTOR ARMANDAS PROPERTOR PROPERTOR PROPERTOR PROPERTOR ARMANDAS PROPERTOR PROPERTO
40	546	22.8	postinkalijuspalinis andržiniojuski susti. Vindinaspauparintonus pastin	73	9.1	white the property of the parameters are a second
41	530	24.4	afelikalismaalatupus maanukatus At, malikata jo siifikka muun	54	6.9	11
42	546	24.2	e orden ed 🛊 No orden som obleven sånetysenhet ården som	72	9.6	enconstant also y a archandran anno sintencent
43	<i>5</i> 32	21.7	-costolybrodninos (see pears (seks-148 -	21	8.2	1)
44	478	15.1	n, Domini Namo varra galjo, anoligani (r. 1875). Anno Sangado van filozoforazion	71	5.2	11
46	568	ે ઢે હ.4	and the same weather appropriate by the construction is approximate taken	73	11.0	11
47	566	26.8	anjardisaansa saardisaansa kasaan Saaqa ayya aha tarabindis	75	11.4	
48	560	25.8	·	75	10.8	11
49	560	25.8	all all a page a lance de productif a agricultación a la productiva companya e	74	10.7	- n
50	560	25.8	wywianiania proposaliwa w www.	74	10.7	1)
51	562	26.9	-consistent Principal Registration - 3072 (April Microsophil Stummon	67	10.1	. 11
52	548	24.9	nucemininosiumennes, a excipensuvianensuini	73	9.9	11
53	546	26.8		57	8.3	1)

(Continued)

SOLAR CELL ELECTRICAL DATA

CELL DESCRIPTION:
Baseline Solar Cells from a HEM Ingot (Vertically Cut)
Gettering by Diffusion Glass after the Chemical Polishing
TEST CONDITION:
TEMPERATURE:

Baseline Solar Cells from a HEM Ingot (Vertically Cut)
Gettering by Diffusion Glass after the Chemical Polishing
AM1 With AR Coating
28°C Test Block

· instantis had because his our moterie in 6 or of		n san Sto at , it debate have being this				
	V _{OC}	^J sc	P _{Max}	CFF	η	AREA
NO.	mV	mA/cm ²	mW	*	*	cm ²
55	554	25,3		74	10.4	3.9
56	540	23.8		69	8.9	//
57	542	24.2		69	9.0	. 11
58	550	<i>25</i> ,3		73	10.2	/1
.59	556	26,3		74	10.8	11
60	556	26.2		70	10.2	.,
	CZ Contr		with out	Gretteri	ng (D	own)
<u>C-1</u>	590	28.8		78	/3.3	3.9
C-2	588	28.4		78	13.0	11
C-3	586	28.3		73	12.1	7)
C-4	588	27.8		79	12.9	11 -
			t			
						All Comments
				orig	INAL PAG	e is
				OF P	OOR QUA	ALY
		:				
	•		•			

APPENDIX IV ELECTRICAL DATA SHEETS FOR DENDRITIC WEB SOLAR CELLS

CELL DESCRIPTION:	Dendritic Web Solar Cells (2x2cm), Baseline Process
•	
TEMPERATURE:	SiQ AR Coating AMI 28°C Test Block 11/80

t and grant of the second of the second	V _{OC}	JSC	P _{Max}	ÇFF	η	AREA
NO.	MV	IIVA/cm ²	mW	A A HARMONI TRANSPORTANT A ARRANG AND THE TOTAL STATE OF THE TOTAL STA	*	cm ²
2	534	28.5	The second secon	76	11.6	4,0
4	532	28.9	arrangen nemanakan ar an	75	11.5	
3. 17 33 A 2821 (MARKE)	530	28.3. va	Adamszon gowernog skiejk al 85 f. – roteksaktájú († 18 90)	76	11.4	U adriannyano ya jami, wa Lingzinganiya in Malinami
. 6	532.	27.4	(2) (2) (2) (2) (2) (2) (2) (2) (2) (2)	75		ne unterstandardo esta secución y constituen
SA - OR HS WE WAR AND AND SHOP	Above	WEB I	D#117-13	73 (=	. 8 ob	m-a.)
12	534	27.8	eriak dier is Tabba rang kang ke ri (1715 - 184 3 tan Meneri (1860 - 1860 -	76	_//.3_	4.0
14	532	28.4	লুফেখ্যসং-ুন্নি ত e hatdon ব্ৰহ	75	11.3	actioned for the spine special participative . Color decident
	5.26	· 283	e erzerosawa w w were e e erzerosawa w worke	.76	11.5	usis gitama agricultus (s.) e rife anticulo. Isi tamb
may on I become tweeter	534		তে, উদ্ভৱত মিলা ব্যৱস্থান প্ৰথম হৈছে । তাৰিক তেওঁ প্ৰথম কৰা কৰিব কৰিব কৰিব কৰিব কৰিব কৰিব কৰিব কৰিব	76	11.4	es assentina en
make rappy to the contract of	Above	WEB I	D# 17-1	377 (=	401	m-a-)
2 /	5/2	27.4	aregumentati, CARLESAN genera - Palenna entitat hantana	76	10.6	4.0
22	518	28.9	राष्ट्राक्षमान्त्रकार्यकार्यमार्थानार्वे क्यांनिक १० व्यांनिक १८ वृत्ताः स्थापनार्थे व्यांनिक १८ वृत्ताः स्थापन	24 - 124 - Comment	11:1	att ataabengementegan '''' talk dag soon in gegyda dawn
23 	512	22.9	g miningras des sections (section of section	74	//.0	AND THE STATE OF THE PART OF THE STATE OF TH
25	512	≥8:∂	ारीमार्थासम्बद्धसम्	75	11,2	SECTION TO THE THE PROPERTY OF THE SECTION OF THE S
2.6	512	29.0	gardydanianth (clinichtillichte) ir Wyr i renthfol a dalli'r W' Wr	14.	11.0	enac maganaganya i Panaman Scare a pri "Schronenanis" a c. del
27	514	18.3	a 2, yang enerektikki dako - goʻ migayya kilebasisi oni	75	10.9	nerangualdinas (Agri Standard V marks) — 22 - Agri varias sena
28	518	28.8	- Paragoneter no no material (a. l. a.) (() () () () () () () () (76	11.3	
29	514	28,4	places to the proposed section of the latter of the section of the latter of the latte	77	11.2	1
Primary (, 1962 19: 1964)(1973) Charles (, 1962)(1977) 19-19 (1964)(1, 1)	aan seessaa ee deemi Amb	ave WE	3 ID #	1/7-135	ola	2 obm-cn
American and Automorphy (25) particles and G. (20) and figures from the commission of	Standardmuch in 1941 S. Baltimershirt (BLSSS)/Esse-	enimeters (1778) at 1784 at 17	statistingstonormanicsens (Link Section) were delibered	g Summa accelegate (C. Theodornau manage M. 446 55 TeV 14	Total of a same of the same of	ang anakasisisisisisisis da da kilokang karandan da kilokasisisisisis a an Malakasis dan karan Papan

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SOLAR CELL FLECTRICAL DATA

CELL DESCRIPTION:	CZ Control Cells (2x2cm) for Web Baseline Process
TEST CONDITION:	SiO AR Coating
TEMPERATURE:	280C Test Block 11/80

) Billist States. As also Ameritary Paraller (b)	V _{OC}	J _{SC}	P _{Max}	CFF	J. 13. MANAGE LANGUAGE	AREA
NO.	mV	mA/cm ²	mW	*	*	cm ²
C. C. Control of the		2 Control	e (ells			A STATE OF THE STA
C-1	588	29,9	eco nnel (1920), successo co successo se se successo su	76	13.5	40
<u> </u>	584	30.0	entroppinge siche, weich auch auch eine sich einer ein in in roser dasch	70	12,2	Marie de la company de la comp
<u>C3</u>	\$82	29,3	11 de 18022 - La figurações Sermagos dicidas Sácals d	7.5	12.8	<u> </u>
c-4	570	29.9	the statement of the st	76	13.4	
n was to be a second	The state of the s	NET Principalinguages ("S) displacements ("One, ethicographical displacements)	in Printers infrarect than the last of the			
elen i rizotar i di di di di komoni di senzano ella	makir. 2349 kassing skop tripi in systösissa skattilika	may same or in mathematical distributions on the last control of the colors of the col	acronomyzynejský štaližnák. S- szaniáo Jósponfárona i	g (1986), blokk anderse þrí semrískeg skeldert, sket að þjórske		and his majeric page a bin in age of species for the species in the page of the single
en speritory (Darson) statistics representation of		esse of the control o	St. General and the state of th	manata timbibadia pane mangaangtangnitangnitang dine		and agus ann ann in proportion beind a 2000 is Shireniannan sporing gardi.
and a supplemental page of the supplemental supplemental pages of the supplemental	erikacija a 1800. uzpierenieni izrobenjarija zakolekološkoci bibori	ekin sangangtakan gasakan pananan sa sakabakan ke m	ng k anadantan nggyap pakalado . 122 ₄₀ alkabaki sankada takannya	and the second s	**************************************	
Miller String or dust country of the page of the particular strike and the country of the strike of	Paris (Marie La Cala), America de Proposito de Calado.	el de la militario de la marca del la marca de la marca del la marca de la marca del la ma	est feet united depleasables to accompanies to accompanies.	enderson and the second se	a y 1 agaigeach y mar den ann an an an	and the state of t
122, 122, 124, 124, 124, 124, 124, 124,	erryande gelstammen. Az szokadas alk erménék sparateur rennyag szentjant számá	Conditionary productions than the property to the Condition of the Conditi	anginingahaning hariak madam padam padam padam sa dibida da maa			
Miles Anny and Top 32 Miles Anny and A	enciji zarac - alebekiron negov antok kwed	神泉は 30年に 2007年 大学は 本語 な ロットのから かご 300 0	and the second of the second o		i in a managa kanamanan kanaman pang terbang kanaman di di di di manaman di	angangangangangan Kabin kabinan meripikangangan
The state of the s	ang ing ka Pangkangga di mengandangga panda Rebibbo-	ক একর বাস্পর্যাপ্তরে প্রথম (C) হাওঁ স্কিন্দর্য ৮ - তথা গাস্প্রদর্যক্ত হারতের	Allekana salahan beranggari Siri (Digi) - banggalan di malahasan bera	ener (1570) de la lacencia de la companya de la lacencia de lacencia de lacencia de la lacencia de lacencia dela lacencia de lacencia de lacencia de lacencia de lacencia de lacencia dela		antunggungg St. 20 a. a. a. antun (antunggellanggilland) Mind
- Propaga Copin Nation (Section Section Sectio	tidacujusistaa – 186 (*) Torringine trassischilikalikalikalikalikalikalikalikalikalik	nn dennier pritikar prijedi i iddice niem ede actor po 2011 - Sanda - I	azilinkanyasitensisterrang etin izilipindasankasikristern	yayayani, Mikidhinki Dirimuuninki yaroyayatiid (jati) ke jadi k		andelagotha Egethi isigi teriga meneriny aydhaga gillafac belin
	P. Addition . D. A. Serranger School	entre en la communicación de Confedentes en en esta esta de constantes de la confedencia en entre en entre en en entre entre en entre e	manamento talan di estatangkalah 1821. Alama nova dan sil terratara	og findag, hadder ac - 14. mars in yngyr ("valutar gyrget, ac 12 kiningri, kapri	*****	e distribution in the service was any family to the service the service.
	akajik menjarinta yang manjajaran percebanan bingkantahin binasa	ing manadistrikang spiritangan iku dalahan dari penggi "igo yi tempsyabanan pelam	angerine in der State in der St	C Commission and American professional programming the profession of the Commission		
The last of the la	ingian kina maa jostu-ee 3,7 materilaa paa 200 aadii 2 kin kina seleen	ngamanahari 1863 Beringama , ngaman "hatiyagayi gabinayan n	कार पर त्रीपाद होने के कि 	a degal dag i dagan reperintang pel penjadang pelap dagan dagan dalam salah dalam salah dalam salah dalam salah		and animal house many trace. "Within its climating, and response
and the second s	The Manager Commence of the State of St	an Promp Bermanyan S. 2004. Also violes and engine to specify prompt the decidion. Also	austring interiment of presidents,	. 4 с 18 год и за применува учивация чен на били на събина и записни	ngg (Magas Pasta Sanc Chadrining and Ground Charles	talah kalundari kemilikan pilangan kalungan kalungan di Salungan kanggan di Salungan kanggan di Salungan kemban
mp To providence is a Maintenan of Employer Copyel of ACC 20th and ACC 20th	de janeare en estación mejarante en e stación del control del con	and the control of th	A STATE OF THE STA	Album Allia kummuyak Markarda yapa pilabayada iya kubi (inin akur ya n		Maked hidde action consenses of the confession o

OF POOR QUALITY

CELL	DESCRIPTION:		Web Solar Cells,		TOWNTY
	•	. With MLAR	Coating	** - Minimum * No report assessor or an employage come mandamentality. Percentification Car	MCCHANTONINONOMO ZALEKĄ JOLOWO WEJSEWY 1997 1997 I WYSELOW - 160 JOSEP ROMINIONOMO SOMOROWY (2004 TOJONE) W 1997 140 JOSEP - 170 W 1997 1
	CONDITION: RATURE:	_AM1 29°C Test	Block	11/20	s opiidonjikan. Mad 1 sa:

் மூல் இந்தி இந்தி இந்தி	v _{oc}	Jsc	P _{Max}	CFF	n	AREA	
NO.	mV	mA/cm ²	mW	*	*	cm ²	
and the second of the second o	556	28.8	AC. APPROXIMATION OF CO.	80	12.9	3, 8	
	556	29.8	elekkingun as juli jakr (sak singsompolyksin	78	12.9	"	
	554	29.4	e antiquenti ja alay os sasaja ali intili 12 Tellimona prop	80	13.0	gancino describios de la compansión de l	
. z . z . z . Z . z . e . e . e .	552 ***********************************	30.0	e de granto populario de de deservición de deservic	78		ne on care some necessarian and controlled and an	
12 / 12 market 14 market 1	530	28.5	a and a second s	78	11.8	Z = 200 Z 2000 S 2000 S 200 S 20	
23	···532	22.7	and an analysis of the second page of	ARRIVAL SAN POPERAGE THE SAME	12.0	· · · · · · · · · · · · · · · · · · ·	
25	528	28.7	- state crate as stated	78	11.9		
स्थीक प्रदेश र नार्थिक क्षकुनार स्थापण र शक्क का उर्थ के स्थापण र	W.	FB Cor	trul cell	(No.	BSFI_)	NEW TOTAL CONTRACTOR C	
	546	283	end menteur de positionistes — sinc l'addinantement yeur	79	/2.2	3.8	
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MI 102.4 THE DES TO A FOR THE SHEET AND ASSESSMENT.	530	28.3	essential de la casa de l'article de l'artic	78	11. 8	//	
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30	526	28.0	skud lukiik luk 5. – mengga lupunda	79	11.7	er en ene e a c'entratamentione nemanique e era-	
32	514	27.4	nter ete en haus alles et autaid i land in de Stein dag de la la stein de la s	79	and dimension	## or necessarium depart (mineralities), Shirt - 25	<u> </u>
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CONTINUED

SOLAR CELL ELECTRICAL DATA

CELL DESCRIPTION:	CZ Control Cells for Web SJ+BS	F Process
TEST CONDITION:	With MLAR Coating AM1	endages (requiremental production of the control of
TEMPERATURE;	28°C Test Block.	11/80

Actual Control of Substitution	NOTE OF A PERSON AND ADDRESS.	A SPECIAL SECTION OF THE SECTION OF	THE WALL	The Commence of the A	* * * * * * * * * * * * * * * * * * * *	
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C-3	582	29.3		78	/3, 2	11
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AND AND AND THE SECOND CONTRACTORS OF T	The state of the s	ner Trenge Salet Treatminister have in servinger 2002 to 300 also everyone	ra i vzára dišudernezymennok v neterné bisodowe rene e		* **	المراجعة المستحدة المراجعة
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		Harring Samuel and Control of the Co	and the second s			

APPENDIX V ELECTRICAL DATA SHEETS FOR EFG SOLAR CELLS

CELL DESCRIPTION:

Baseline Cells From EFG Grown CO-off And CO-on Atmosphere With AR.

TEST CORDITION:

AM1

TEMPLIKATURE:

28°C Test Block Temperature.

1			n	1	1 1	
	V _{oc}	^J sc	P	CFF	n	AREA
ΝΟ.	mV	::A/cm ²	lnW	%	%	cin ²
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2	538	23,5	ti wi i piakabwi-a	64	9. Landana a	
3	540	22,2	,	77.	9,2	and the second second of the s
7	542	23.0	- Lå Båddoj do Stilleren en stat	69	8.5	and the contract of the contra
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	558	24,6	公安医子宫 医二十二苯 电压压 医髓囊 医皮肤	76	10.5	usee warenemen -
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<u> </u>	586	28,4	operan is missemplanes service and constitute constitute and other	28	12.9	4
C 2	580	27.5		72	12.4	1,
<i>c</i> 3	580	28,5	nggapapanhankhankanisanisa sacara sa sisimmenasian pambig bankha	78	12.9	. "
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And the state of t						
- Income despendent to the despendent of the contract of the c		, and the 100 Market				

CELL DESCRIPTION: EFG Baseline Cells (2x2cm) with Low Temperature Annealing
No AR

TEST CONDITION: AM1
TEMPERATURE: 28°C Test Block Temperature

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	v _{oc}	^J sc	P _{Max}	CFF	n	AREA	
NO.	mV	mA/cm ²	mW	*	*	cm ²	
2	492	/3,3	e artisalise de de la	75	4.9	4	7
tamin se of the market with	498	13.4	in the special state of the sp	76	5.0	()	18/7/20
8	494	13.4	manyelmenteksi periodis papagis – dat hilberadeksi alma dimanlemente	75	4,9		17
10	488	13,3	stantonnia okanistika (1824 – 18 00 finalistantonia) e	64	4./	4] }
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	498	13.2	THE STATE OF THE S	76	\$.0		-K &
24	484	12.7	* Siessiania - Amerika - A Homerstein seedyteen	72	4.5		187
28	500		T 186. ŠBSTĀLIJAN INO ANIQUINIS - 17 PRINNINS NIKSJASSKI (PRAN	74	5./		$\int_{\mathbb{R}^{3}}$
30	500	13.7	economic company of the company of t	74	5.1	r construency of the sign of t	18/-18/
34	492	13.3	NC Dect/Men.co.a Minescopic in the comprehensive property and	76	4.8		1) .
36	490	/3.⊄	ng-ng-zg/fenthaushishessig/fi she e-mesamanthausig/fetten	68	4.4	/,	1
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3	484	/3, 2	gyddioddiol ddionaigau, ac a sgyrghwyddionyd o gyddiol g	77	4.6		1
<u> </u>	428	12.7		72	45		
7	486	12.3	Szyládáságatta altanuszcznycz many maj prodpina dziejekologogów, od s	18	4.6		
9	500	13.7	k 1974-billion kalamannan kon di 12 niya jihan nanajihala da saka	75	5.1		
//	496	/3, 2		75	4,9	4	

SOLAR CELL FLECTRICAL DATA (CONTINUED)

CELL DESCRIPTION:	EFG Baseline Cells (2x2cm) with Low Temperature Annealing
TEST CONDITION: TEMPERATURE:	AMI 28°C Test Block Temperature

	v _{oc}	^J sc	P _{Max}	CFF	n	AREA
NO.	mV	mA/cm ²	mW	a thine or	*	cm ²
. /3	484	12.8	A. M. CONT. THE STATE OF THE ST	73	4,5	<u> </u>
. 12.	510	14.3	on themsely set interest seems to have a cheer measure or a	77	5.6	
	500	13,2	10 (M) 118 (C) <u>Marie Marie Marie Marie Marie Marie Marie M</u>	75	5.0	4
23	502	13.9	The State and any angua consumer on the second state and any	14	ے ہی	٠,
25	490	12.7	1.7 \$17 Augustine and the state of the state	74	4,6	4
- 27. marie	47.8	12.8		63	3,9	1,
2 9	494	/B.3		75	5.0	
	496		- of decision associations to grave the "C of the desired transformation and	75	5.1	
3/7	492	12.7	F-austrickings germanistige (NES SESSION Elleren, men st	76	4.7	angunania san Lacaras. a
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<u>C3</u>	5-68	20.0	was a second or consequent of the contract of	74	8.4	4
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APPENDIX VI ELECTRICAL DATA SHEETS FOR SOLAR CELLS FROM TWO STEP DIFFUSION

ALCO DATE TOTAL TOTAL PAIN

वात, भड़दराकान्यः,	EFG Cells (2x2cm) with Two Step Diffusion	**
TEST CORPUTEON:	NO AR AMO	239
High BADAP (28°C Test Block Temperature	•

	v _{oc}	Jsc	PMix	CFF	n	ARE A
HO.	_ inV	:-A/cm ²	mW	%	%	cm ²
8	46.4	14.8	· · · · · ·	67	3, 4	4
/2	470	14.8		23	3.7	enco mmunication de la companya del companya del companya de la companya del companya de la companya de la companya del companya de la companya del companya de la companya del companya de la companya de la companya de la companya de la companya
14	468	14.3	ar i kasa ar	69	3.5	n managan na atau da atau a sa s
18.	476	16./	r - Franciscopy, pagino - P.C. Tit. St.	70	4.0	···· · · · · · · · · · · · · · · · · ·
20	476	16.2	- Tre virtuality of majority () and the 100 tables		3.7	active and the second state
22	476	15:17	. Vaget kroke - elikise biolikk - 3:	69	3.8	Y
30	472	15.	- Jac Bac securities in the section of the control	70	3.7	mineranium, dei sebarat Minerani
kon *	rr	a c du	- · · · · · · · · · · · · · · · · · · ·	No twi	stan de	Lacion
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. 3	506 494	17.7	in the communication of the co	7/	4.6	A p
9	498	18.7	COSC M. SON CONTROL OF STREET, ST. STR. STREET, ST. STR. STR. STREET, ST. STR. STR. STR. STR. STR. STR. STR.	66	4.6.	-
12	498	10.6	4 MARKEMEN AUTOROUT ON THE PROPERTY OF A WINNER	69	4.5	an commencency consists, Marietanisms and
	502	18.6	غان د اور در الفار المارية الم	68	4.7	araga mar ani
25 mm	490	17.6	ng producery accommon april (19 pl 2019) app representation	72	4.6	
27_	480	15.7	g di vist sammen nie enemität en 25 - y 3238ik zellenet sammet	70	3.9	"
29	500.	/3./	TO A CONTROL OF THE PARTY OF TH		4.4	<u> </u>
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THE AR CHIL THORRICAL RATA

SILSO Cells (2x2cm) with Two Step Diffusion CELL DESCRIPTION: No AR TEST CONDITION: AM1 TEMPLERATURE: 280C Test Block Temperature Jsc Voc \mathbf{P}_{Max} AREA CFF NO. $_{\rm fsA/cm}^2$ cm² ıηV % mW 6.1 520 21.6 73 6.6 8. 532 22,0 7675 53.8 22.0 14 6.7 540 22.6 72 6.9 531 2.د 64 5.8 18 536 .23.0 Wacken control cells No two stop diffusion 5 175 6.5 528 22./ 4 540 6.7 13 22,5 15 6.9 542 22,5 26 4 15 17 76 6.9 540 22,6 ٠

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